

Recognition of Hijaiyah Letters with Punctuation Using Augmented Reality

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ABSTRACT

Learning hijaiyah letters is an initial step to reading the Al-Qur'an. Because the Al-Qur'an is written in Arabic using hijaiyah letters with special punctuation. Currently, learning hijaiyah letters still uses simple media in the form of books, posters, display boards, etc. so it is less interesting. The rapid development of technology allows mobile devices to become smartphones that can be used as learning media. Therefore, mobile devices can be used for learning hijaiyah letters to make them more attractive. One technology that can be utilized is Augmented Reality which can combine the virtual world with the real world in the form of 3D through applications accessed on mobile devices. This research developed the introduction of hijaiyah letters equipped with punctuation and pronunciation using marker based augmented reality. The development of mobile application applies the Mobile Application Development Lifecycle (MADLC) method. The development of augmented reality applications utilizing Blender, Vuforia and Unity 3D Game Engine. The results of the Black box testing show that all functional requirements have been met and are running well.

Keywords: Augmented reality; Hijaiyah letter; MADLC; Mobile, Punctuation

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1. INTRODUCTION

Al-Qur'an is the holy book that must be read by all Muslims. In 2018 the results of research from the Institute of Qur'an Sciences (Institut Ilmu Al-Qur'an), noted that around 65% of Indonesian people are illiterate in the Qur'an [1]. Many factors can influence this situation, one of the reasons is because not everyone has the opportunity to fully learn to read the Al-Qur'an. Learning hijaiyah letters is an obligation that must be learned in order to be able to read the Al-Qur'an. The basic thing that must be known and understood in reading the Al-Qur'an is knowing the hijaiyah letters and how to read them [2]. Because the Qur'an is written in Arabic using hijaiyah letters, so how to read hijaiyah letters must be understood first. The process of learning hijaiyah letters that has been going on so far uses lecture methods and demonstrations with simple media [3]. The teacher explains the hijaiyah letters and demonstrates how to read them while the students listen and then follow along with imitating them. The media usually used are iqra books, tilawati books, posters or display boards. The process of recognizing hijaiyah letters like this is less interesting in learning. Therefore, a more interesting and interactive media for the introduction of hijaiyah letters is needed so that students become more interested and can understand the hijaiyah letters better.

In the era of the industrial revolution 4.0, technology has developed rapidly and is widely used in various fields. And now entering the era of society 5.0, people are required to coexist with technology and utilize technology. The rapid development of technology in cellular phones is now not only used as a medium of communication but has become a smartphone that can be used as a medium of information, learning, entertainment and so on [4]. People cannot be separated from gadgets in their daily life. Currently the application of technology in the field of education is needed. One of them is by creating learning media in digital form that can be accessed in devices that are widely used by the community. One of the developments in technology that can be used in learning is augmented reality (AR) which can display various objects such as text, images, sound, 3D and video [2]. AR combines real and virtual worlds, that enhances or augments additional information (digital content) onto the real world [5]–[7].

Several applications for recognizing the hijaiyah letters using augmented reality have also been developed. Chan, et al developed AR for Iqra Book that enhance by 3D of hijaiyah letter [8]. Application for recognizing the hijaiyah letters with AR which is equipped with punctuation marks developed by Septian and Agustian but there is no way of pronouncing it [2]. Further research by Asbara is in the form of recognizing hijaiyah letters without punctuation but can make sounds [3]. Another study conducted by Fadli and Ishaq has developed an AR application for recognizing hijaiyah letters without punctuation but equipped with pronunciation and simple exercise features [5]. Therefore, in this research an application for recognizing hijaiyah letters with AR was developed which was equipped with punctuation and pronunciation. Besides that, to make it more interactive, a question practice feature is added which consists of several levels according to the user's abilities. This research is intended to be able to develop an AR application for recognizing hijaiyah letters which can make learning hijaiyah letters more interesting and interactive.

2. RESEARCH METHOD

This research follows Mobile Application Development Lifecycle (MADLC) to develop the mobile application for recognizing hijaiyah letters using augmented reality which was equipped with punctuation and pronunciation. MADLC is suitable for this research because can accommodate the unique features and complexities of developing mobile applications. MADLC consists of seven phases as follows: identification, design, development, prototyping, testing, deployment and maintenance [9], [10]. Figure 1 shows the MADLC phases carried out in the development of the mobile application in this research.

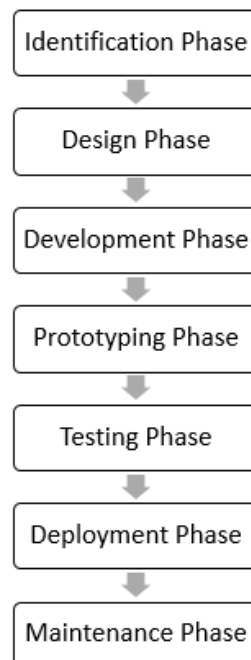


Figure 1. MADLC Phases

The first phase is called identification phase by collecting any ideas to come out with a new idea or improvements to the existing application. Based on the results of literature studies and observations related to the application of hijaiyah letter recognition with AR, initial requirements were gathered at this phase. The functional requirement for the application proposed in this research are :

- a. The application can identify objects and scan marker through the camera device.
- b. The applications can display 3D objects equipped with punctuation and audio pronunciation.
- c. The applications can add punctuation when 3D hijaiyah letters appear.
- d. The application can display basic materials for hijaiyah letters and punctuation.
- e. The applications can display quizzes with several levels.
- f. The application can display user manual information.

In the design phase, all the idea gathered in the identification phase developed into an initial design of mobile application. At this phase also important to create the storyboard of application. Storyboard describes the flow of the application by designing the user interface interaction [10]. This research will develop a marker based augmented reality, therefore it is necessary to design several markers with a number of hijaiyah letters which will be used as markers to display 3D objects.

The development phase can be divided into two stages namely coding for functional requirement and coding for user interface. The development of hijaiyah letters in 3D objects using Blender. Blender is an open source software used to build 3D content [5], [11]. Blender supports all 3D workflows such as modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game development. To develop the augmented reality, this research combine the Vuforia Software Development Kit (SDK) with the Unity 3D Game Engine. Vuforia SDK is an AR software development kit for mobile device that utilizes computer vision technology to recognize and capture planar images or 3D objects in real time [12]. Unity 3D is a cross-platform integrated 3D game engine that can superimpose the virtual onto reality and realizes human computer interaction with some AR development tools [12].

In the prototyping phase, the mobile application that has been developed is checked by an expert through an emulator. The blackbox testing is carried out on the application prototype is ensured to have fulfilled all functional requirements and there are no errors in the application. The next phase is testing the application on a real device by exporting the application to the packaging installer, namely the APK format. The performance testing is carried out to test application performance on various operating system versions and variable screen sizes. After the testing is completed, in the deployment phase the application is uploaded to the appropriate application store or market. The final phase of MADLC model is the maintenance phase which is a continuous process to make improvement according to the user feedback.

3. RESULTS AND DISCUSSION

The result of this research is a mobile application for recognizing hijaiyah letter equipped with punctuation and pronunciation using augmented reality called AR Hijaiyah. The functional requirements of AR Hijaiyah application is modeled in the Use Case Diagram of UML (Unified Modeling Language) as shown in Figure 2. There is one actor, namely user who has used the AR Hijaiyah application on mobile devices.

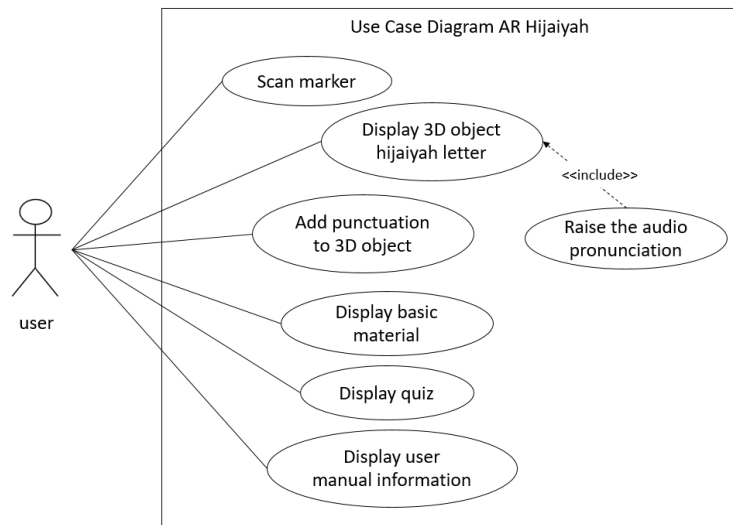


Figure 2. Use Case Diagram of AR Hijaiyah

Another result of this research is the marker that will be used for AR scans. There are 30 markers for each alphabet in hijaiyah letters that have been created and added to the Vuforia database. The marker is in the form of a different barcode for each hijaiyah letter. The barcode will be combined with the marker design that has been made to detect 3D objects from hijaiyah letters. An example of a marker that has been created is shown in Figure 3. The marker also has a rating that can affect the appearance of 3D objects in the application. Markers that get a rating of more than three stars can be said to be unique or good because the level of appearance of 3D objects in the application will be easier.



Figure 3. Example of marker of AR Hijaiyah

Figure 4 shows the main screen of the AR Hijaiyah application that appears when the user opens the application for the first time. The main screen contains six menus, namely scan AR to display 3D objects of hijaiyah letters equipped with punctuation, user manual to view the application usage instructions along with download markers, material to view basic materials of hijaiyah letters and punctuation accompanied by audio pronunciation, quizzes containing exercises questions related to the hijaiyah letter material, about to see information on the Augmented Reality application, and the exit menu to exit the application.



Figure 4. Main screen of AR Hijaiyah

After selecting the Scan AR menu, application will access the camera device and enter the Scan AR screen. Figure 5 shows the AR Scan screen that has succeeded in displaying 3D objects according to the markers. On this screen there are three buttons that are used to add punctuation marks to 3D objects of hijaiyah letters. These buttons include fathah, kasrah, and dhammah buttons and each button also has its own function. The fathah button to add fathah punctuation marks to hijaiyah 3D objects that appear according to the marker used. The kasrah button to add kasrah punctuation marks to the 3D hijaiyah letters that appear. The dhammah button to add dhammah punctuation to 3D hijaiyah letters. In addition, there is a back button for returning to the main screen.



Figure 5. Scan AR Screen

On the scan AR screen there is a feature to add punctuation marks to the 3D objects that appear. To add a fathah punctuation mark, the user must select the fathah button, then the application will display the punctuation mark on a 3D object of hijaiyah letters that appear according to the marker used along with the audio of the pronunciation. Figure 6 shows 3D hijaiyah letters that have been added fathah at the top of the object, so that the user understands how to read hijaiyah letters. If the user wants to remove the fathah punctuation that has appeared, the user only needs to click the fathah button again. Likewise to add signs of kasrah and dhammah punctuation to 3D objects.



Figure 6. Scan AR Screen with Punctuation

The Material Screen contains choices of hijaiyah letters and punctuation as shown in Figure 7. If the user selects hijaiyah letters, they will be redirected to a material page that contains an introduction to hijaiyah letters along with their audio pronunciation. And if the user selects punctuation material, they will be directed

to the material page which contains an introduction to punctuation which are accompanied by audio pronunciation.



Figure 7. Material Screen

On the Quiz Screen there are three levels of quizzes, namely easy, medium and difficult levels as shown in Figure 8. The easy level contains questions on separate hijaiyah letters equipped with punctuation marks, the medium level contains questions on connected hijaiyah letters at a medium level, and the difficult level contains connected letters hijaiyah at a difficult level. Each level has ten questions and is accompanied by pronunciation audio. The final score will appear when the user has answered all a available questions. On this Score Screen there is a repeat button which is used to repeat the quiz from the beginning and there is a home button which is used to return to the main screen.



Figure 8. Quiz Screen

After the application has been successfully developed, it is then tested using the blackbox method which focuses on application functionality. The results of this Blackbox test can be seen in Table 1. The test results show that all the functionality of the application is running well and there are no errors.

Table 1. Table of Blackbox Testing Result

Feature	Expected Result	Obtained Result	Status
Scan Marker	Marker can be recognized	Marker can be recognized	Accepted
Display 3D Object	Displays 3D hijaiyah letters according to the marker	Displays 3D hijaiyah letters according to the marker	Accepted
Raise the audio pronunciation	Audio appears according to the selected hijaiyah letters	Audio appears according to the selected hijaiyah letters	Accepted
Add punctuation	The selected punctuation mark appears on the 3D object	The selected punctuation mark appears on the 3D object	Accepted
Display basic material	Material options appear on the Material screen	Material options appear on the Material screen	Accepted
Display quiz	Quiz option appear	Quiz option appear	Accepted
Display user manual information	Application guidance information appears	Application guidance information appears	Accepted

4. CONCLUSION

Based on the results of the research and discussion above, a mobile application for recognizing hijaiyah letters equipped with punctuation and pronunciation using augmented reality has been developed. The application developed in this research can be an alternative media for learning hijaiyah letters that are more interesting and interactive. With the use of augmented reality which is equipped with punctuation and pronunciation, it is hoped that it can help people learn hijaiyah letters well. Currently the application is being developed for Android, for further research, the application for learning hijaiyah letters can be developed for other platforms. In addition, for further development other quiz variations can also be added.

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